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Resident and user support for urban natural areas restoration practices

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ABSTRACT

Public support is important to the success of natural areas restoration programs. Support can be especially critical in urban settings where stakeholders recreate in or reside near natural areas but may lack familiarity with practices for managing ecological processes. Surveys of on-site recreationists and nearby residents (N = 888) of 11 Chicago metropolitan natural areas were used to assess support for eight different practices commonly used in oak woodland restoration. Support generally ranged in relation to the level or intensity of management intervention, from more than 90% of the sample supporting the planting of native seeds and plants to just 32% supporting the use of herbicides to control undesired vegetation. On-site users and nearby residents who believed that a restoration practice was being used at the site they visited and/or lived near were much more likely to support the use of that practice than those who did not believe or did not know whether it was being used. These belief variables were the most important predictors in binary logistic regression models of restoration support, though gender (female) also significantly decreased the likelihood of supporting most high-intervention practices. Beyond these findings, results also suggest that support should be viewed as a multidimensional concept that involves perceptual, demographic, and structural components which often differ for different practices. Managers can use the information provided here to increase their understanding of the relative nature of restoration support and devise holistic social-ecological strategies to achieve restoration success.

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1. Introduction

How does one measure the success of an ecological restoration program? Although ecologists often focus on ecological factors such as species diversity, vegetation structure, and ecosystem processes to evaluate the success of their efforts (Ruiz-Jaen and Aide, 2005), it is being increasingly acknowledged that program success also depends upon addressing social factors such as how a restoration looks and how it can be used by the public (Brooks et al., 2013; Wortley et al., 2013). Preferences, use, and other human dimensions of natural resource management are especially important in urban settings, where large numbers of residents may live close to or recreate in natural areas but may not be familiar with the tools and techniques for maintaining natural communities. The failure of managers to implement urban restorations without regard to public stakeholders can result in a loss of support for their programs, compromising ecological goals and diminishing the potential of restored areas to provide unique human benefits not attainable in conventional urban green spaces (Kaplan et al., 1998; Ingram, 2008).

Such a loss of support happened in Chicago 20 years ago, when in the spring of 1996 an ecologically successful program in the Forest Preserve District of Cook County was halted by policymakers in response to public opposition to restoration activities at some sites (Gobster, 2000). The moratorium lasted a full 10 years on a few of the sites (Anon, 2006), and though restorationists initially downplayed the magnitude of opposition (Shore, 1996; Siewers, 1998), a county-wide resident survey conducted by Barro and Bright (1998) shortly after the start of the moratorium showed that both support for and concerns about management were widely shared. In their analysis, the researchers noted a disconnect in respondents' attitudes toward restoration, with a more than 90% approval for the overall goals of restoration programs but with 75% or more expressing disapproval of specific practices needed to achieve those goals, including removal of mature trees and use of herbicides.

This is not just an isolated local or urban issue, and studies done in rural and wildland areas in the U.S., Europe, Australia, and elsewhere echo this disconnect between the ends and means of restoration goals and practices (e.g., Cary and Williams, 2000; Dandy et al., 2011; Shindler et al., 2012; Woodworth, 2013). Though it should come as no surprise to land managers that different practices are greeted with differing levels of support among public stakeholders, there is little

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systematic evidence for how a set of techniques commonly used in restoration are perceived and supported. Furthermore, little is known about the social factors underlying people's support for restoration and whether and how those factors might vary across different practices. Finally, few studies have attempted to understand how structural factors such as stakeholder group type and management style might influence support.

The aims of the research presented here are to address these knowledge gaps in the context of natural areas management programs in the Chicago metropolitan region. Although much progress has been made on both ecological and social fronts since the days of the 1996 moratorium, conflicts still occasionally arise (Woodworth, 2013). By focusing on the research needs mentioned above within this regional context, it was also hoped that a more systematic analysis might clarify why some practices identified by Barro and Bright (1998) lacked wider support. On a broader level, because most studies of people's response to natural areas management have taken place in rural and wildland settings, a major motivation of our research was to contribute managerially relevant knowledge to the growing international activity in urban ecological restoration with respect to how moderate- to high-level management interventions are perceived and accepted within an urban context (Gobster, 2010).

1.1. Public support for restoration practices

People's preferences for urban nature are long established in the environmental social science literature (e.g., Kaplan and Kaplan, 1989), though early studies often looked more generically at public green space composed of undifferentiated trees and other vegetation. More recent work aimed at understanding the ecological characteristics of urban nature has greater relevance for natural area management and some findings show that higher levels of species diversity and similar measures of ecological quality also correlate with increased preference and use of natural environments (Jorgensen and Gobster, 2010; Hunter and Luck, 2015). But this is not always the case, and for some people urban natural areas that exhibit such characteristics can appear messy and untended, and this perceived lack of care and disorder is often construed as a sign of mismanagement (Nassauer, 1995; Hands and Brown, 2002). Moreover, even if people appreciate the visual and recreational outcomes of a natural area restoration project, they may object to the tools or practices used to achieve that outcome (Shindler et al., 2002). For these reasons, social scientists are increasingly looking at people's support or acceptance of specific management practices to gain a more nuanced understanding of what makes a successful restoration program.

Ecological restoration usually involves some combination of practices to enhance native species diversity, vegetation structure, and ecosystem processes, though specific actions can vary widely by ecosystem type and geographic region. In the Midwestern U.S. where our study takes place, practices used in prairie, oak savanna, and oak woodland restoration often include: planting and seeding of native plants; hand weeding, mechanical removal, prescribed burning, and herbicide application to control undesired flora and maintain desired flora; and fencing and sharpshooting to control overabundant fauna, mainly white-tailed deer (*Odocoileus virginianus*) (Packard and Mutel, 2005). We contend that the degree of public support for these practices will vary inversely by the intensity or perceived level of intervention into nature, with high support for relatively benign activities such as seeding and planting of natives and lower support for high intervention activities such as burning, herbicide use, and lethal deer removal.

Evidence to support this hypothesis is scattered within the research literature, with much of the work focusing on individual practices. Studies that comprehensively address a set of ecological restoration practices are particularly sparse as they relate to urban areas. Besides the work by Barro and Bright (1998) already mentioned, a study by Miller et al. (2002), also conducted in metropolitan Chicago, examined residents' attitudes toward prescribed burning as a tool in ecological restoration and found support for that practice by nearly 3/4 of respondents across their nine-county study area. Levels of support for other practices (acceptable in some cases/all cases) included thinning invasive trees in woodlands (71%), deer control (68%), removing shrubs (64%), clearing trees from prairies (51%), and spraying herbicides (40%). In another study of urban natural areas in Michigan, Ryan (2005) found park users held slightly positive attitudes toward controlled burning, were neutral on cutting down non-native trees and shrubs, and were slightly negative on spraying herbicides to eliminate non-native shrubs. In a regional study of sagebrush ecosystem restoration in the Great Basin of the U.S., Shindler et al. (2012) found high public acceptance among urban and rural residents for practices such as prescribed fire, grazing, and tree and shrub removal but low support for herbicide use and chaining (i.e., removing shrubs by dragging a heavy chain between two vehicles).

Beyond these comprehensive studies, there is a larger body of international research on public support for individual practices in restoration and other management contexts that help inform our study. A number of studies have examined people's perceptions of native plants in urban parks and natural areas (Daumants, 2003; Schulof, 1989; Schwartz et al., 2014). Findings from this work generally show a high appreciation and support for the use of natives, though some people prefer more formal and ornamental plant selections (Khew et al., 2015) and may oppose the removal of non-natives to solely favor native plantings (Kendle and Rose, 2000; Foster and Sandberg, 2004). Much has been written on preferences and social acceptability of tree cutting in the context of wildland timber harvesting (e.g., Ribe, 1989), with people generally tolerant of light thinnings but more often opposed to removal of large trees and extensive areas of trees (i.e., clearcutting). These same concerns can apply to ecological management, particularly when the goals entail restoring closed semi-natural and plantation forests to more open woodland, savanna, and grassland ecosystems (e.g., Cary and Williams, 2000; De Valck et al., 2014). A number of studies have examined public support for prescribed fire to reduce accumulated ground fuel loads and associated wildfire risk in fire-dependent ecosystems, particularly in urban-wildland interface areas (e.g., Bell and Oliveras, 2006; Ryan, 2012). Findings from this work generally show high support, though levels of support can vary significantly from study to study (Toman et al., 2014). People's perceptions of herbicide and other chemical applications for weed and pest control have been studied with respect to forestry (e.g., Norgaard, 2007; Howle et al., 2010), farm and rangeland (e.g., Doohan et al., 2010; Evans and Rollins, 2012) and residential lawn (Larson et al., 2010; Blaine et al., 2012) management. While the landowner-based studies we reviewed (mostly North American focused) showed that a majority of respondents used chemicals to control weeds, those studies that looked at broader public groups and public land applications found respondents generally had negative perceptions of their use. Finally, many studies have been conducted to examine public perceptions of deer control in metropolitan (e.g., Kilpatrick et al., 2007; Urbanek et al., 2012; Johnson, 2014) and rural/peri-urban (Dandy et al., 2011) settings, to reduce vegetation damage as well as vehicle collisions. Much of this work examines public support for different control options and most studies find at least moderate support for some type of control, though results vary widely from study to study.

1.2. Factors affecting support

Information about relative levels of support for restoration practices is helpful in designing a socially acceptable program, but it is also important to understand the social factors underlying that support. We contend that support can be predicted from beliefs and perceptions of nature and its management, knowledge and experience with environmental and restoration issues, and different social-demographic and structural characteristics of the population. This hypothesis builds

upon the two Chicago-based studies mentioned above and is informed by related literature on restoration and broader aspects of land management.

For the Chicago work, Bright et al. (2002) found that positive and negative restoration attitudes were related to beliefs about perceived outcomes (including specific practices), value orientations, and objective knowledge about restoration as well as emotional responses and participation in various environmental and stewardship activities. Additionally, Miller et al. (2002) found that those who were aware that different restoration activities were taking place on natural areas in the region were significantly more likely to support prescribed burning than those who were not aware. Respondents' residential proximity and frequency of visits to natural areas did not affect support for burning, nor were there any major differences in support across social-demographic characteristics.

In other restoration-related work, Connelly et al. (2002) found support for ecosystem restoration goals in the Hudson River estuary of New York State most strongly correlated with knowledge about the river environment, beliefs about its management, and participation in environmentally-related activities, with weaker but significant correlations with socio-demographic variables related to education. Ostergren et al. (2008) found that support for ponderosa pine forest restoration in north-central Arizona was influenced by attitudes toward the purposes of restoration, with differences in attitudes varying significantly by level of education and urban-rural residency. Toledo et al. (2013) examined landowner attitudes toward the use of high-intensity prescribed burns to restore brush-encroached grasslands in Texas. Significant social factors leading to a positive attitude toward burning included landowners' previous experience, necessary skills and knowledge, risk taking orientation, and subjective norms. Finally, Safford et al. (2014) found that awareness, attitude, and socio-demographic variables helped to predict support for resource protection and restoration efforts for Puget Sound in Washington State.

Beyond research specific to restoration, Shirmer and Bull (2014) found that rural landowner attitudes and perceptions about costs, benefits and risks; beliefs about land management and climate change; knowledge and previous experience with tree planting; and social-demographic and property characteristics influenced willingness to adopt afforestation projects for carbon sequestration as part of a climate change mitigation strategy in New South Wales, Australia. Kooistra and Hall (2014) identified Colorado resident support for different forest management options in the wake of a major pine beetle outbreak to be influenced by social and ecological attitudes, gender, and political orientation. Finally, Johnson (2014) found that residents' acceptability ratings for various deer reduction strategies in Connecticut were influenced by beliefs about the effectiveness of the particular technique, attitudes about their negative effects, tolerance for deer capacity levels, as well as gender and political ideology.

1.3. Questions for research

The research findings summarized here helped guide us both initially in designing our survey and later in structuring our analyses to contribute to the larger body of knowledge on public support for natural areas management. While there are some commonalities across regions and ecosystems, the suite of practices available to restoration managers often varies, and the earlier work in Chicago helped us to select individual practices for use in our study. The social factors used to model public support can also vary by stakeholder group and disciplinary or researcher interest, though this review confirms that variables related to people's beliefs and perceptions, experience and use, and demographic and other structural characteristics of their social groups can be important predictors. Finally and significantly for structuring our analyses, much of the recent work cited above suggests that the strategy of developing multiple models of support for individual practices may ultimately be more useful from practical and theoretical standpoints than relying on a single, generalized model of support. With this conceptual and analytical background in hand, the research presented here examined public support for the restoration of Chicago metropolitan natural areas. Two sets of questions are addressed:

1. What is the level of public support for different ecological restoration practices? Are there variations by site, management style, and/or stakeholder group?
2. What factors predict public support for restoration? Do these factors differentially predict support for different practices?

2. Methods

2.1. Research setting

Our research was conducted within the context of the coupled human and natural systems RESTORE project (Rethinking Ecological and Social Theories of Restoration Ecology), the primary goal of which was to examine whether and how organization-based decision making processes or "management styles" lead to observable differences in on-the-ground ecological outcomes (Heneghan et al., 2012). The ecological focus of the RESTORE project was on restoration of upland oak woodland and oak savanna ecosystems, and 11 natural areas governed by manager-led ($n = 5$), co-managed (manager-volunteer) ($n = 4$), and researcher-led ($n = 2$) styles of management were identified in metropolitan Chicago that had been under active restoration management for at least five years. Site selection and study objectives were guided by a transdisciplinary team of scientists and practitioners affiliated with Chicago Wilderness, an alliance of some 250 member institutions aimed at conserving biodiversity in Chicago metropolitan region.

While the central emphasis of the RESTORE social science team was on uncovering the rules and interactions among those involved in restoration decision making (Watkins et al., 2013), the present study was initiated in recognition that restoration also happens in a broader public context and that public stakeholders can affect and be affected by natural areas and their management. For these reasons, two additional criteria for RESTORE site selection were that each of the natural areas had public access and was located close to a residential area. Two stakeholder groups were identified for the 11 sites: on-site users of public facilities such as trails, and nearby residents who lived within 1/2 mile (c 0.8 km) of a site. Note that a major part of the larger RESTORE project involved personal interviews with individuals who manage or otherwise have responsibilities at a given site. To maintain their anonymity, ethical guidelines for social science research prevents us from naming or geographically delineating the 11 natural areas used in this research project and for this reason only general site descriptions can be given.

2.2. Respondent sampling

Different strategies were used to sample each of the respondent groups for survey distribution (Fig. 1; see Westphal et al., 2014 for complete details). For the on-site survey, each of the 11 RESTORE natural areas were visited and mapped to locate points along trails or near parking lots where on-site users were later intercepted. The on-site surveys were conducted between June and September of 2011; the survey team visited each site three times (two weekend days and one weekday), avoiding days with adverse weather conditions. Adult visitors were intercepted on a quasi-random basis and at an interval dependent on the number of individuals present at the site. Refusals were usually <10% at low use sites, but were higher at some high use facilities that were crowded or along major recreational trails. The main reasons for refusal were that individuals did not want to break from their activity or were simply not interested in participating. User totals for sites ranged from 1 (a bird watcher at a remote site) to 60, resulting in a total sample of on-site users of $n = 259$.

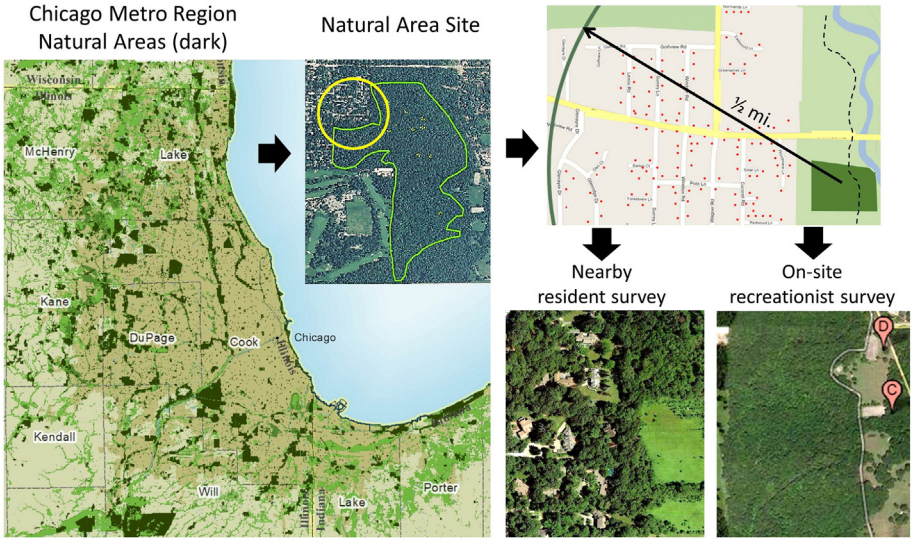

Fig. 1. Sampling strategy.

For the nearby residents' survey, we purchased a postal mailing address list from a private survey sampling company identifying all residences within 1/2 mile of each natural area. We purposefully oversampled addresses directly adjacent to sites (for another facet of the study not reported here) and randomly selected the others. Adapting the Tailored Design Method of Dillman et al. (2009), we initiated the survey in October 2011 with a pre-notice postcard mailing to 5127 addresses, inviting participants to complete the survey online. A second mailing with cover letter, survey, and postpaid return envelope followed a week later, and a reminder/thank you postcard followed a week after that. Accounting for undeliverable addresses, the protocol resulted in a disappointing response rate of 6%.

With the holiday season approaching, rather than continue on with another mailing, we resumed data collection efforts the following May using the Drop-off/Pick-up (DOPU) method (e.g., Steele et al., 2001). While considerably more labor intensive, this door-to-door method provides the opportunity for personal contact between the researcher and respondent, and has been shown to substantially increase response rates (Allred and Ross-Davis, 2011). This boosted our response rate to 13%, yielding a total sample of nearby residents of n = 629 and per-site samples ranging from 33 to 88.

The total sample for the survey was N = 888 across on-site users and nearby residents, yielding an average of n = 81 respondents per natural area site and n = 296 respondents per management style.

While our total sample and subgroup sizes provide ample precision for our analyses (Dillman et al., 2009), we used various means to check for possible non-response bias. First, we phoned a subsample of mail survey non-respondents. The main reasons given by those who answered were that they did not recall receiving the survey, were too busy, or that they thought it was part of a fundraising effort (the postcards and survey were mailed out with the logo of the Field Museum of Natural History, which was one of the participating institutions). We also had a 10% refusal rate among nearby residents we encountered while dropping off the DOPU survey. Here the major reasons for declining to participate were lack of time or lack of interest in the topic. We also compared demographic data from the surveys for each site with 2010 US Census data from their corresponding census tracts. Our resident sample, averaged across all sites and compared with census data averages tended to have a slightly larger percentage who were white (88% vs 81%), female (59% vs. 52%) and higher income ($115 k vs $94 k). The sample was also somewhat older (median 56 vs 43 years) and much more educated (47% post-graduate training vs 25%). These differences parallel those between our resident and on-site samples (Table 1) and as those did not lead to major differences in support for restoration practices, we feel reasonably confident in the generalizability of our resident sample to the population of those who live near our study areas.

2.3. Measures

An eight-page Urban Natural Areas Survey was developed to assess how people think about and use natural areas in metropolitan Chicago (see Supplemental Material for full surveys). Items selected from the survey for use in this analysis were designed to assess urban nature and restoration perceptions, beliefs about and support for restoration practices, experience and use of nearby natural areas, and social and demographic characteristics (see Table 2).

Perceptions about restoring nature in the city were measured by a set of nine items adapted from Bright et al. (2002) assessing respondents' perceptions about the importance of different benefits or ecosystem services that Chicago-area restoration efforts provide. We also included a Connectedness to Nature scale adapted from Schultz (2001); see also Vining et al., 2008) that asked respondents to circle which of the five overlapping Venn diagrams best represented their perceived degree of overlap between self and nature.

Beliefs about and support for restoration were assessed for each of eight practices commonly used in oak woodland restorations in the Midwestern U.S. The practices were selected based on previous work by Miller et al. (2002) and expanded upon in consultation with local restoration experts. These experts helped with the specific wording describing each practice to ensure that it was technically correct and avoided any potential bias of negative portrayal (see comment by Osmund (1999) and reply by Barro and Bright (1999)). The items were subsequently pretested with a sample of laypersons (n = 12) for clarity, and the final set was included in the survey as follows:

- Planting native seeds and seedlings
- Removal of undesired plants, shrubs and small trees by hand or with the use of hand tools
- Mechanical removal of undesired shrubs and small trees (e.g. by chainsaw)
- Removal of undesired mature trees
- Using herbicide on undesired plants, shrubs, or trees
- Controlled burns to control undesired plants and encourage native ones (controlled burns are prescribed fires undertaken by experts)
- Exclusion of overabundant and destructive deer (fencing)
- Removal of overabundant and destructive deer (professional sharp shooters)

Table 1
Socio-demographic characteristics of the study sample.

	Nearby residents (N = 629)	On-site users (N = 259)	Total (N = 888)
Gender			
Female	58.5%	56.3%	57.9%
Male	41.5%	43.7%	42.1%
Income			
<$25 k	4.1%	8.2%	5.5%
$25–50 k	10.5%	13.0%	11.4%
$51–100 k	29.7%	36.5%	32.2%
$101–$150 k	23.5%	23.1%	23.4%
>$150 k	32.2%	19.2%	27.5%
Education			
<High school	0.2%	0.8%	0.4%
High school	4.9%	7.7%	5.8%
Some college	12.3%	12.2%	12.3%
College degree	36.0%	41.5%	37.6%
Post-graduate	46.7%	37.8%	44.0%
Age			
18–24	0.4%	6.1%	2.1%
25–35	5.8%	9.8%	7.0%
36–50	29.2%	24.2%	27.7%
51–65	37.6%	41.8%	38.9%
>65	27.1%	18.0%	24.4%
Mean age	56.0	51.0	54.6
Race/ethnicity			
Asian	3.9%	3.6%	3.8%
Black	5.1%	6.7%	5.6%
Hispanic	1.4%	2.7%	1.8%
White	88.2%	81.2%	86.1%
Mixed/other	1.4%	5.8%	2.7%

To assess beliefs regarding restoration practices, we asked respondents if they thought whether each of the restoration techniques "happens here," "does not happen here," or "don't know." To assess support for the practices, respondents were shown the same set of techniques and asked whether they "support" the action, "do not support" the action, or "don't know."

Experience and use related to the natural area at which restoration was taking place were measured by assessing frequency of visitation (4-point scale ranging from "first time/rarely" to "at least once a week") and frequency of participation in on-site stewardship-related activities (4-point scale ranging from "never" to "regularly").

Social and demographic measures assessed by the questionnaire included gender (M/F), income (5 levels), education (5 levels), and age (open-ended). Structural characteristics of the sample coded from the surveys included management style (manager, co-led, and researcher), site (11 natural areas), and stakeholder type (on-site user or nearby resident).

2.4. Data analysis

To model restoration support, the eight support measures of restoration practices were treated as dependent variables, and the belief and perception, experience and use, social-demographic, and structural sample measures were treated as independent variables for analysis.

Because our primary interest was in predicting support for a practice, each dependent variable was recoded as binary—support, do not support/don't know. For the independent variables, the eight belief measures about restoration practices were similarly recoded as binary—happens here or doesn't happen/don't know. This type of coding is a common practice for dichotomous choice questions, and similar research shows that don't know responses are more similar to no responses (Groothuis and Whitehead, 2002). For the nine perception items we developed a summative Restoration Benefit index, which had an acceptable level of inter-item consistency as determined by the Cronbach's alpha statistic ($\alpha = 0.767$). Connectedness to Nature, frequency of site visitation, participation in stewardship, income, education, and age were treated as continuous variables following Vaske (2008), while gender, survey type, and management style variables were treated as categorical.

Binary logistic regression models of restoration support were developed for six of the eight practices (responses for two practices, planting and hand weeding, were so highly skewed toward support that we did not include those measures in modeling efforts). The dependent variable in each model was support for the restoration practice in question.

Table 2
Model variables and measurement.

Construct/variable	Questionnaire items	Measurement scale
Support for practices (8 items)	Check whether you support the action, do not support the action, or you don't know (see text for wording of each practice).	0 = do not support/don't know; 1 = support
Beliefs about practices (8 items)	Check whether you think the following restoration techniques happen at this site, do not happen at this site, or you don't know.	0 = does not happen/don't know; 1 = happens here
Perceptions of restoration benefits $\alpha = 0.767$	Restoring natural areas in and around Chicago would: Increase the natural beauty of the metropolitan area; Decrease recreational opportunities; Help combat the effects of global climate change; Decrease air quality; Preserve plants and animals that are in danger of becoming extinct; Decrease the amount of tourism and its economic benefits; Improve water quality in the metropolitan area; Maintain the region's natural heritage; Increase the number of unique and interesting plants and animals that exist in the metropolitan area	1 = strongly disagree; 2 = disagree; 3 = neutral; 4 = agree 5 = strongly agree (summated scale used in statistical models)
Connection to nature	Which of the following diagrams best represents how connected you feel with nature in your everyday life?	Diagrams show: 1 = 0%; 2 = 10%; 3 = 25%; 4 = 50%; 5 = 100%
Site visitation frequency	How often do you visit *site*?	1 = never; 2 = rarely; 3 = a few times a year; 4 = at least once a month; 5 = at least once a week
Participation in stewardship activities	Have you ever participated in nature stewardship activities at *site*?	1 = never; 2 = once; 3 = a few times; 4 = regularly
Gender	Are you	0 = male; 2 = female
Income	What was your total household income last year, before taxes?	1 ≤ $25 k; 2 = $25-50 k; 3 = $51–100 k; 4 = $101–150 k; 5≥ $150 k
Education	What is the highest level of education you have completed?	1 = less than HS diploma; 2 = HS diploma; 3 = "some college"/no degree reported; 4 = college degree; 5 = postgraduate education
Age	How old are you?	Open-ended; coded as continuous
Survey type	n/a	0 = On-site; 1 = nearby
Management style	n/a	1 = Co-managed; 2 = manager; 3 = research

Variables included in the models can be found in Table 2. The linearity assumption was checked using the Box-Tidwell approach where natural log transformations were created for each continuous variable in the model, the interaction terms were added to the model, and terms were inspected to ensure interaction terms were non-significant (Fox, 2015). Variance inflation factors were examined to ensure they were in acceptable range to check collinearity. Reported significance was at $p \leq 0.05$ unless otherwise noted.

Data exploration revealed that approximately half of the survey responses were being lost due to listwise deletion of observations, as the regression program drops any observation that does not have complete data for every variable. Multiple imputation was performed using chained equations (*mi impute chained* command in Stata v. 14), the imputation method most appropriate for a mix of continuous and categorical variables (StataCorp, 2015). Forty-five datasets were imputed using all of the variables in the models based upon the largest fraction of missing information (StataCorp, 2015). Each dataset was then analyzed and results combined (Rubin, 1987) using the *mi estimate: logit* command for each model of restoration support. Traditional goodness-of-fit tests do not readily apply when pooling imputed datasets, and thus are not reported here (White et al., 2011).

3. Results

3.1. Support for restoration practices

For the entire sample, support for specific restoration practices ranged from a nearly unanimous 94.5% for planting native seeds and seedlings to a low of 32.4% for using herbicide on undesired plants, shrubs, or trees (Fig. 2). As expected, there was a high degree of support for low intervention practices like planting and hand weeding, with a general decline in support as the intensity or perceived degree of management intervention increased. An exception to this was controlled burning, which had a high (81%) overall degree of support. Lower levels of support for a practice did not always mean that respondents did not support its use, and for fencing and mature tree removal the percentage of respondents who checked "don't know" was about equal to those who checked "don't support."

When examined by survey subsample, nearby residents and on-site users differed little from each other in their support for the eight restoration practices. Two low-intervention practices, hand and chainsaw removal, were more highly favored by nearby residents (90% and 74%) than on-site users (83% and 62%). Similarly, only two significant differences in support were found as a function of management style: Respondents as a whole were much more supportive of excluding deer with fencing in researcher-managed natural areas (72.0% vs 46.0% and 48.2% for co-managed and manager sites, respectively) and somewhat less supportive of controlled burning in co-managed areas (73.3% vs 87.7% and 82.2% for manager and researcher sites, respectively). There were a number of differences in support for practices across the 11 natural area sites, though with the large number of sites and relatively small per-site sample sizes, findings must be interpreted cautiously. The biggest range of between-site differences included high levels of support for controlled burning (96.3%), chainsaw removal (86.4%), and herbicide use (47.4%) at a natural area that is a focal point of a restoration-focused conservation community; and low levels of support for controlled burning (54.1%), shooting deer (22.7%), and herbicide use (24.3%) at the only site in our sample that was located within the City of Chicago.

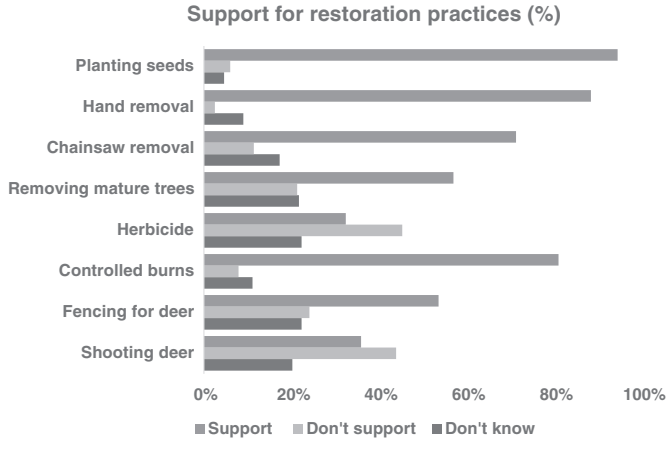

Fig. 2. Response frequencies of support for restoration practices (N = 817 to N = 838 depending on item).

3.2. Models of restoration support

All six models of restoration support were significant, and results showed that belief a practice was being used at the natural area was a highly significant predictor of support across all models (Table 3). Respondents' belief that a practice "happens here" increased the odds for their support of that practice from 4- (tree cutting) to 12- (burning) fold. While the belief variables were conceived and coded as dichotomous choices, Fig. 3 shows there was considerable uncertainty among respondents about the use of a practice as reflected by high percentages of "don't know."

The only other variable that was significant across most models was gender, where females were from 0.38 (shooting deer) to 0.74 (fencing) as likely as males to support a practice. Gender, however, was not a significant indicator of support for controlled burning, and so while females seem to be generally less supportive of some restoration practices than males, the high p value and nearly neutral odds ratio shows essentially no difference between the sexes in support for the use of fire in restoration.

Besides the belief variables and gender, the two structural variables had significant effects on restoration support but only for specific practices. Nearby residents were 1.5 times as likely to support removing mature trees and twice as likely to support mechanical removal of shrubs than on-site users. Management style was significant in the burning and fencing models, where support for burning at manager-led sites was 1.9 times more likely than at co-managed sites, and support for fencing was about 1.7 times as likely at researcher-led sites than co-managed.

The other variables marginally and inconsistently helped to predict restoration practice support across models. The restoration benefit index had a statistically significant but weak positive effect (OR = 1.049, $p = 0.014$) in the mature tree removal model, as it did in the controlled burn (OR = 1.046) and fencing (OR = 1.032) models with a less stringent p-value cutoff ($p < 0.1$). More frequent participation in stewardship activities was associated with increased support of removing mature trees, herbicide use, and controlled burns. Income was significantly and positively related to support of controlled burning, use of herbicides, and mature tree removal. Age was significant in only one model, mature tree removal, where increased age was associated with greater support.

4. Discussion and management implications

This study examined public stakeholder support for ecological restoration practices in the context of oak ecosystems in metropolitan Chicago. From our survey of 888 respondents who lived near or visited one of eleven natural areas we found varied support across eight commonly used practices, with high support for practices such as planting and hand weeding and lower levels of support for practices such as using herbicides and shooting deer. We also found that among a varied set of attitudinal, social-demographic, and structural independent variables that beliefs about the use of a practice at a site and gender consistently

Table 3
Binary logistic regression models of restoration support.

	Support chainsaw removal of shrubs and small trees				Support removal of mature trees				Support herbicide use			
Predictor	Odds ratio	SE	t	p	Odds ratio	SE	t	p	Odds ratio	SE	t	p
Belief that (practice) "happens here"	4.175	0.869	6.870	0.000	3.910	0.739	7.220	0.000	5.711	1.277	7.790	0.000
Restoration benefits index	1.002	0.021	0.060	0.940	1.049	0.020	2.460	0.014	0.974	0.020	−1.270	0.203
Connectedness to nature	1.092	0.102	0.940	0.345	0.883	0.080	−1.370	0.170	1.070	0.104	0.700	0.485
Site visitation	10.990	0.077	1.350	0.177	1.000	0.066	−0.010	0.996	1.026	0.071	0.380	0.705
Stewardship	1.202	0.169	1.310	0.189	1.414	0.179	2.740	0.006	1.288	0.153	2.120	0.034
Gender (male)*	0.608	0.108	−2.790	0.005	0.687	0.110	−2.350	0.019	0.619	0.105	−2.820	0.005
Income	1.139	0.108	1.370	0.170	1.169	0.109	1.670	0.095	1.232	0.112	2.300	0.022
Education	0.991	0.099	0.400	0.690	0.849	0.081	−1.720	0.086	0.993	0.100	−0.070	0.946
Age	1.038	0.097	0.400	0.690	1.223	0.107	2.330	0.020	1.100	0.105	1.000	0.317
Sample (onsite)*	2.080	0.425	3.590	0.000	1.516	0.291	2.170	0.030	1.009	0.208	0.040	0.967
Management style (co-managed)*												
Manager	0.882	0.172	−0.650	0.518	0.896	0.161	−0.610	0.537	1.133	0.218	0.650	0.518
Research	0.732	0.156	−1.460	0.144	0.851	0.170	−0.810	0.419	1.300	0.275	1.230	0.219
Constant	0.336	0.312	−1.170	0.240	0.075	0.066	−2.930	0.003	0.185	0.173	−1.800	0.072
F	6.520				7.230				7.940			
p	0.000				0.000				0.000			
	Support controlled burning				Support fencing for deer				Support shooting deer			
Predictor	Odds ratio	SE	t	p	Odds ratio	SE	t	p	Odds ratio	SE	t	p
Belief that (practice) "happens here"	12.324	3.675	8.420	0.000	3.933	0.997	5.400	0.000	4.953	1.200	6.600	0.000
Restoration benefits index	1.046	0.025	1.870	0.061	1.032	0.019	1.720	0.087	0.982	0.020	−0.910	0.365
Connection to nature	1.146	0.130	1.200	0.229	0.879	0.075	−1.520	0.129	1.068	0.098	0.720	0.470
Site visitation	0.901	0.076	−1.240	0.216	1.003	0.062	0.050	0.959	1.024	0.068	0.360	0.720
Stewardship	1.418	0.296	1.670	0.094	0.991	0.107	−0.080	0.936	1.136	0.124	1.170	0.242
Gender (male)	1.030	0.222	0.140	0.889	0.744	0.115	−1.920	0.055	0.381	0.062	−5.900	0.000
Income	1.368	0.159	2.700	0.007	1.043	0.083	0.520	0.601	1.146	0.104	1.510	0.132
Education	0.908	0.144	−0.770	0.441	1.138	0.103	1.430	0.154	1.012	0.098	0.120	0.904
Age	1.066	0.117	0.580	0.560	1.140	0.096	1.550	0.122	1.107	0.100	1.120	0.262
Sample (onsite)	0.859	0.227	−0.570	0.566	1.226	0.226	1.100	0.270	0.811	0.157	−1.090	0.278
Management style (co-managed)												
Manager	1.902	0.466	2.620	0.009	1.046	0.174	0.270	0.785	0.949	0.175	−0.280	0.778
Research	1.067	0.277	0.250	0.803	1.737	0.387	2.480	0.013	0.854	0.179	−0.750	0.451
Constant	0.067	0.073	−2.490	0.013	0.115	0.098	−2.550	0.011	0.466	0.428	−0.830	0.407
F	8.270				5.500				7.040			
p	0.000				0.000				0.000			

* Variable categories in parentheses were used as the reference categories.

predicted support for most practices, while other variables were significantly associated with only one or a few specific practices.

4.1. Variations in support

The variation in support for low versus high intervention practices that we hypothesized was generally consistent with the literature (e.g., Shindler et al., 2012). However, among the practices we considered as high intervention we were somewhat surprised by the high (81%) level of support for controlled burning. This figure exceeds the level of support (73%) expressed by Chicago area residents ten years earlier by Miller et al. (2002), and while the question phrasing and sampling frame were somewhat different, this generally upward trend in support over time should be encouraging to managers who rely on burning as a key tool in restoration efforts. One potential explanation may be that after two decades of controlled burns on metropolitan Chicago prairie and oak ecosystems, those who live near and frequently visit these sites have become familiar with the practice and aware of its benefits. This rationale parallels the findings of related research on prescribed fire as a tool in wildland fuels reduction, where higher levels of familiarity and experience predict higher levels of public acceptance across a number of studies (McCaffrey and Olsen, 2012). But we also found a considerable range in support for controlled burning and other high intervention practices among respondents across the eleven different natural areas in our sample. A likely explanation for high support at one site was that it lies adjacent to a planned conservation community that draws many residents because of the natural landscape that is a key feature of the development. Conversely low support at the only site in our sample within the City of Chicago may be due to higher residential density and greater social diversity of respondents.

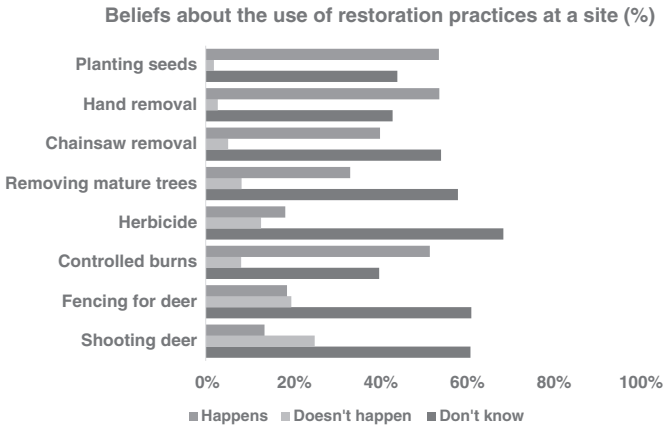

Fig. 3. Response frequencies for beliefs about the use of restoration practices at a site (N = 823 to N = 858 depending on item).

In light of such differences, managers should be sensitive to the physical characteristics of the neighborhoods surrounding their sites and the social-cultural perceptions and preferences of local residents. For example, management at sites that lie in close proximity to many residents or have residents that are likely not familiar with restoration might proceed at a slower pace and smaller scale than what might be possible more remote sites or those where there is a readily receptive

audience (Ryan, 2000, 2012). Additionally, around sites where significant support is lacking for the implementation of certain practices managers might choose alternative means of accomplishing goals, even if they are more costly or labor intensive (Gobster, 2012). Finally, managers can employ educational tools such as guided tours and site design cues such as fencing or mowing along edges, nature trails, signage, and/or attractive gateway plantings to help residents perceive the underlying care of management (Nassauer, 1995).

4.2. Beliefs

Our broad hypothesis that support for restoration practices could be predicted from a combination of attitudinal, social-demographic and structural variables also yielded somewhat unexpected findings with regard to the dominance of the belief and gender variables across most models. Respondents who stated that a given restoration practice was being used at the site they were visiting or lived near were much more likely to support use of that practice, and these belief variables ended up being the single biggest predictors of support across all models. We originally patterned these items as measures of knowledge or awareness based on the work of Miller et al. (2002), and while most of the practices did in fact occur at most of the sites, mature tree removal was not practiced at four of the eleven sites and the two deer control practices were not used at six of the sites. But in coding them for the modeling efforts we discovered that it didn't matter whether or not a practice was actually being used at the site—a respondent's belief that they were being used was much more effective in determining their support for using it. On the surface this might seem like an issue of social science semantics, but while knowledge and awareness purport to measure some objective, external reality about the nature of the world, beliefs can be much more subjective (Allen et al., 2009). Moreover, beliefs can have a normative component to them such that if a person feels that a practice is socially acceptable or trusts those who might implement it, they would be more likely to believe that the practice is being used. Such was the case with Toledo et al.'s (2013) work on prescribed burning mentioned earlier, and other studies have similarly found beliefs to be important in predicting decisions about land use (e.g., Nassauer et al., 2009; Cook and Ma, 2014; Toman et al., 2014). Beliefs have also been shown to have an important connection to the desired outcomes of management (Toman et al., 2014; Urbanek et al., 2015). In the case of our project, it may be that if respondents liked the look of the natural area and/or enjoyed visiting it, those positive outcomes could reinforce their beliefs about the use of, and in turn support for, practices that are producing those outcomes.

While further research is needed on how the elements of trust and beliefs about desired outcomes influence support for restoration practices discussed in this paper, the basic concepts have relevance to natural areas management (Metcalf et al., 2015; Urbanek et al., 2015). By emphasizing the positive outcomes resulting from management interventions, managers might more successfully make the case for their use than if programs such as herbicide spraying or deer removal are communicated without a clear expression of desired outcomes. Any dialog communicating these connections must be credible and ensure confidence otherwise managers may risk losing the trust of their stakeholders, and if a practice lacks support among some constituents, managers should be prepared to demonstrate how benefits are maximized and risks minimized, that alternative practices will not achieve the desired outcomes, and that they are willing to listen to stakeholder concerns and incorporate them into management decisions to the extent possible.

4.3. Gender

Along with beliefs, gender was a consistent predictor of support in our models, with females less likely than males to support restoration all of the practices we examined except for burning. This finding is generally supported in the literature on environmental concern, particularly with respect to issues like herbicide use where there are potential health and safety risks (Xiao and McCright, 2015). While some researchers have interpreted lower support by females as a function of their vulnerability to environmental degradation, the negative association of vulnerability to victimization has led others to broaden the discourse on gender with respect to environmental issues, in part reframing women as agents of change (Broeckhoven and Cliquet, 2015). Gender has also been found to be a significant predictor of support for deer control, with females more often opposed to lethal control than males (e.g., Lauber and Knuth, 2004; Dougherty et al., 2003). For this practice, values and ethics have been offered as explanations for lower support among females, who expressed higher concern than males about issues such as pain and suffering of the animal (Lauber and Knuth, 2004) and had a more nuanced moral reasoning in considering the acceptability of techniques to manage deer populations (Dougherty et al., 2003).

Broeckhoven and Cliquet (2015) argue for greater inclusion of a gender dimension into restoration policy and practice, and though the focus of their perspective is on women who are directly engaged in carrying out restoration projects, their ideas also apply to the broader group of female stakeholders such as residents and users that indirectly influence and are influenced by restoration. Managers should not assume that all restoration practices are gender neutral and should recognize that some practices may have disproportionate impacts on the values and ethical systems of female stakeholders. Efforts should also be made to ensure adequate representation of stakeholders in restoration decision making to reduce potential bias, including gender bias (Dougherty et al., 2003). And even if gender is not a significant factor in support for some practices such as it was for fire in our study, the inclusion of a full range of voices in decisions about restoration can enrich managers' understanding of how individual practices are perceived and experienced (Norgaard, 2007).

4.4. Other factors

In addition to the belief and gender relationships just discussed, our models also showed how other attitudinal, social-demographic, and structural variables uniquely contributed to explaining support for specific practices. Of these, two merit further elaboration. Our restoration benefits scale was significantly associated with mature tree removal, as well as with burning and fencing a less stringent p-value cutoff, but the nearly 1:1 odds ratios show that the scale added little to improving prediction of support for those practices. One explanation for the lack of a stronger relationship may be that the restoration benefits included in the scale may have been too broad to link more strongly to specific decisions about restoration support (Heberlein, 2012). Some researchers have made the distinction between public and private benefits, suggesting that individuals may be more supportive of programs and practices where they can see how they might personally benefit ((Pannell et al., 2006; Januchowski-Hartley et al., 2012). Using an example from our study, instead of asking nearby residents whether “Restoring natural areas in and around Chicago would…improve water quality in the metropolitan area,” it might be more effective to ask “Restoration at (site name) will help reduce flooding of homes in my neighborhood.” Increased understanding about the benefits of restoration could lead to better ways for managers to communicate to constituents and gain support for their efforts.

Management style was a significant predictor for two of the models and also merits elaboration. We included this structural variable as part of the larger objectives of the RESTORE project, which sought to assess the relationships between managerial decision making styles and ecological outcomes. While the present study does not directly inform this relationship, it does provide some indication that management style may have an influence on the social acceptability of some practices, specifically heightened support for burning in management-led sites

and fencing in researcher-led sites. These relationships make intuitive sense when considered in the broader contexts of expertise (Helford, 2000) and institutional purpose, and while they may not directly affect ecological outcomes, they may alter strategies for how one accomplishes restoration objectives. For example, training and certification programs may help build public confidence in the management expertise of restoration volunteers who are key co-managers in many urban restoration programs.

5. Conclusions

If a single answer can be given for the disconnect noted by Barro and Bright (1998) in people's attitudes between the ends versus means of ecological restoration, it is that support for ecological restoration can be best understood by examining support for the individual practices that are used to address restoration goals. For oak ecosystems in fragmented, urbanized landscapes these include light-handed practices such as planting and hand-weeding that are fully supported by residents and natural area visitors. But our findings also show that these stakeholders may hold more differentiated views about the use of other practices such as burning, cutting mature trees, using herbicides and shooting deer. While beliefs help explain support for all of the different practices examined in this study, support should be viewed a multidimensional concept that involves attitudinal, demographic, and structural components which often differ for different practices. This idea has relevance beyond our case study and such factors should be considered by restoration managers in maximizing the success of their programs.

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Appendix A. Supplementary data

Supplementary data to this article can be found online at http://dx.doi.org/10.1016/j.biocon.2016.09.025.

References

Allen, S.D., Wickwar, D.A., Clark, F.P., Dow, R.R., Potts, R., Snyder, S.A., 2009. Values, Beliefs, and Attitudes Technical Guide for Forest Service Land and Resource Management, Planning, and Decision-Making. Gen. Tech. Rep. PNW-GTR-788. USDA Forest Service, Pacific Northwest Research Station, Portland, OR.

Allred, S., Ross-Davis, A., 2011. The drop-off and pick-up method: an approach to reduce nonresponse bias in natural resource surveys. Small-scale For. 10, 305–318. http://dx.doi.org/10.1007/s11842-010-9150-y.

Anon, 2006. Steele Lifts Moratorium. Friends for. Preserves 6. p. 1.

Barro, S.C., Bright, A.D., 1998. Public views on ecological restoration: a snapshot from the Chicago area. Restor. Manag. Notes 16, 59–65. http://dx.doi.org/10.3368/er.16.1.59.

Barro, S.C., Bright, A.D., 1999. Reply: appearances-and science. Ecol. Restor. 17, 3–4. http://dx.doi.org/10.3368/er.17.1-2.3.

Bell, T., Oliveras, I., 2006. Perceptions of prescribed burning in a local forest community in Victoria. Aust. Environ. Manag. 38, 867–878. http://dx.doi.org/10.1007/s00267-005-0290-3.

Blaine, T.W., Clayton, S., Robbins, P., Grewal, P., 2012. Homeowner attitudes and practices towards residential landscape management in Ohio, USA. Environ. Manag. 50, 257–271. http://dx.doi.org/10.1007/s00267-012-9874-x.

Bright, A.D., Barro, S.C., Burtz, R.T., 2002. Public attitudes toward ecological restoration in the Chicago metropolitan region. Soc. Nat. Resour. 15, 763–785. http://dx.doi.org/10.1080/08941920290069344.

Broeckhoven, N., Cliquet, A., 2015. Gender and ecological restoration: time to connect the dots. Restor. Ecol. 23, 729–736. http://dx.doi.org/10.1111/rec.12270.

Brooks, J., Waylen, K.A., Mulder, M.B., 2013. Assessing community-based conservation projects: a systematic review and multilevel analysis of attitudinal, behavioral, ecological, and economic outcomes. Environ. Evid. 2, 1–34. http://dx.doi.org/10.1186/2047-2382-2-2.

Cary, J., Williams, K., 2000. The Value of Native Vegetation: Urban and Rural Perspectives. Res. Rep. RR 3/00. Land and Water Resources Research and Development Corp., Canberra, Australia.

Connelly, N.A., Knuth, B.A., Kay, D.L., 2002. Public support for ecosystem restoration in the Hudson River Valley, USA. Environ. Manag. 29, 467–476. http://dx.doi.org/10.1007/s00267-001-0033-Z.

Cook, S.L., Ma, Z., 2014. The interconnectedness between landowner knowledge, value, belief, attitude, and willingness to act: policy implications for carbon sequestration on private rangelands. J. Environ. Manag. 134, 90–99. http://dx.doi.org/10.1016/j.jenvman.2013.12.033.

Dandy, N., Ballantyne, S., Moseley, D., Gill, R., Peace, A., Quine, C., 2011. Preferences for wildlife management methods among the peri-urban public in Scotland. Eur. J. Wildl. Res. 57, 1213–1221. http://dx.doi.org/10.1007/s10344-011-0534-x.

Daumants, L., 2003. Factors Affecting Visual Preferences for Naturalization and Restoration in Urban Park Landscapes (MA Thesis) University of Guelph, Guelph, Ont.

De Valck, J., Vlaeminck, P., Broekx, S., Liekens, I., Aertsens, J., Chen, W., Vranken, L., 2014. Benefits of clearing forest plantations to restore nature? Evidence from a discrete choice experiment in Flanders, Belgium. Landsc. Urban Plan. 125, 65–75. http://dx.doi.org/10.1016/j.landurbplan.2014.02.006.

Dillman, D., Smyth, J., Christian, L., 2009. Internet, Mail, and Mixed-Mode Surveys: The Tailored Design Method. third ed. Wiley, New York.

Doohan, D., Wilson, R., Canales, E., Parker, J., 2010. Investigating the human dimension of weed management: new tools of the trade. Weed Sci. 58, 503–510. http://dx.doi.org/10.1614/WS-D-09-00086.1.

Dougherty, E.M., Fulton, D.C., Anderson, D.H., 2003. The influence of gender on the relationship between wildlife value orientations, beliefs, and the acceptability of lethal deer control in Cuyahoga Valley National Park. Soc. Nat. Resour. 16, 603–623. http://dx.doi.org/10.1080/08941920309187.

Evans, M., Rollins, K., 2012. The frying pan or the fire: public attitudes about using herbicides to manage invasive weeds. Environ. Econ. 3, 108–121.

Foster, J., Sandberg, L.A., 2004. Friends or foe? Invasive species and public green space in Toronto. Geogr. Rev. 94, 178–198. http://dx.doi.org/10.1111/j.1931-0846.2004.tb00166.x.

Fox, J., 2015. Applied Regression Analysis: Generalized Linear Models. Sage, Los Angeles.

Gobster, P.H., 2000. Introduction: Restoring Nature: Human Actions, Interactions, and Reactions. In: Gobster, P.H., Hull, R.B. (Eds.), Restoring Nature: Perspectives from the Social Sciences and Humanities. Island Press, Washington, DC, pp. 1–20.

Gobster, P.H., 2010. Special symposium on urban ecological restoration. Nat. Cult. 5, 227–363. http://dx.doi.org/10.3167/nc.2010.050301.

Gobster, P.H., 2012. Alternative Approaches to Urban Natural Areas Restoration: Integrating Social and Environmental Goals. In: Stanturf, J., Lamb, D., Madsen, P. (Eds.), Forest Landscape Restoration: Integrating Natural and Social Sciences. Springer, New York, pp. 155–177.

Groothuis, P.A., Whitehead, J.C., 2002. Does don't know mean no? Analysis of ‘don't know’ responses in contingent valuation questions. Appl. Econ. 34, 1935–1940. http://dx.doi.org/10.1080/00036840210128717.

Hands, D.E., Brown, R.D., 2002. Enhancing visual preference of ecological rehabilitation sites. Landsc. Urban Plan. 58, 57–70. http://dx.doi.org/10.1016/S0169-2046(01)00240-710.

Heberlein, T.A., 2012. Navigating Environmental Attitudes. Oxford University Press, New York.

Helford, R., 2000. Constructing Nature as Constructing Science: Expertise, Activist Science and Public Conflict in the Chicago Wilderness. In: Gobster, P.H., Hull, R.B. (Eds.), Restoring Nature: Perspectives from the Social Sciences and Humanities. Island Press, Washington, DC, pp. 119–142.

Heneghan, L., Mulvaney, C., Ross, K., Umek, L., Watkins, C., Westphal, L.M., Wise, D.H., 2012. Lessons learned from Chicago Wilderness—implementing and sustaining conservation management in an urban setting. Diversity 4, 74–93. http://dx.doi.org/10.3390/d4010074.

Howle, M.B., Straka, T.J., Nespeca, M.C., 2010. Family forest owners' perceptions on chemical methods for invasive species control. Invasive Plant Sci. Manag. 3, 253–261. http://dx.doi.org/10.1614/IPSM-D-09-00012.1.

Hunter, A.J., Luck, G.W., 2015. Defining and measuring the social-ecological quality of urban greenspace: a semi-systematic review. Urban Ecosyst. 18, 1139–1163. http://dx.doi.org/10.1007/s11252-015-0456-6.

Ingram, M., 2008. Urban ecological restoration. Ecol. Restor. 26, 175–177. http://dx.doi.org/10.3368/er.26.3.175.

Januchowski-Hartley, S.R., Moon, K., Stoeckl, N., Gray, S., 2012. Social factors and private benefits influence landholders' riverine restoration priorities in tropical Australia. J. Environ. Manag. 110, 20–26. http://dx.doi.org/10.1016/j.jenvman.2012.05.011.

Johnson, B.B., 2014. Bases of support differ for deer reduction versus behavior change options to manage deer impacts, human dimensions. Hum. Dimens. Wildl. 19, 33–46. http://dx.doi.org/10.1080/10871209.2013.819596.

Jorgensen, A., Gobster, P.H., 2010. Shades of green: measuring the ecology of urban green space in the context of human health and well-being. Nat. Cult. 5 (3), 338–363. http://dx.doi.org/10.3167/nc.2010.050307.

Kaplan, R., Kaplan, S., 1989. The Experience of Nature: A Psychological Approach. Cambridge University Press, New York.

Kaplan, R., Kaplan, S., Ryan, R.L., 1998. With People in Mind: Design and Management of Everyday Nature. Island Press, Washington, DC.

Kendle, A.D., Rose, J.E., 2000. The aliens have landed! What are the justifications for ‘native only’ policies in landscape plantings? Landsc. Urban Plan. 47, 19–31. http://dx.doi.org/10.1016/S0169-2046(99)00070-5.

Khew, J.Y., Yokohari, M., Tanaka, T., 2015. Public perceptions of nature and landscape preference in Singapore. Hum. Ecol. 42, 979–988. http://dx.doi.org/10.1007/s10745-014-9709-x.

Kilpatrick, H.J., Labonte, A.M., Barclay, J.S., 2007. Acceptance of deer management strategies by suburban homeowners and bowhunters. J. Wildl. Manag. 71, 2095–2101. http://dx.doi.org/10.2193/2007-058.
Kooistra, C.M., Hall, T.E., 2014. Understanding public support for forest management and economic development options after a mountain pine beetle outbreak. J. For. 112, 221–229. http://dx.doi.org/10.5849/jof.13-004.
Larson, K.L., Cook, E., Strawhacker, Hall, S.J., 2010. The influence of diverse values, ecological structure, and geographic context on residents' multifaceted landscaping decisions. Hum. Ecol. 38, 747–761. http://dx.doi.org/10.1007/s10745-010-9359-6.
Lauber, T.B., Knuth, B.A., 2004. Effects of information on attitudes toward suburban deer management. Wildl. Soc. Bull. 32, 322–331 (http://dx.doi.org/10.2193).
McCaffrey, S.M., Olsen, C.C., 2012. Research Perspectives on the Public and Fire Management: A Synthesis of Current Social Science on Eight Essential Questions. Gen. Tech. Rep. NRS-104. USDA Forest Service, Northern Research Station, Newtown Square, PA.
Metcalf, E.C., Mohr, J.J., Yung, L., Metcalf, P., Craig, D., 2015. The role of trust in restoration success: public engagement and temporal and spatial scale in a complex social-ecological system. Restor. Ecol. 23, 315–324. http://dx.doi.org/10.1111/rec.12188.
Miller, C.A., Campbell, L.K., Yeagle, J.A., 2002. Attitudes of Residents in the Greater Chicago Region Toward Prescribed Burns and Ecological Restoration: A Report to the Chicago Wilderness Burn Communications Team. Hum. Dimens. Prog. Rep. SR-02-02. Illinois Natural History Survey, Champaign, IL.
Nassauer, J.I., 1995. Messy ecosystems, orderly frames. Landsc. J. 14, 161–170. http://dx.doi.org/10.3368/lj.14.2.161.
Nassauer, J.I., Wang, Z., Dayrell, E., 2009. What will the neighbors think? Cultural norms and ecological design. Landsc. Urban Plan. 92, 282–292. http://dx.doi.org/10.1016/j.landurbplan.2009.05.010.
Norgaard, K.M., 2007. The politics of invasive weed management: gender, race, and risk perception in rural California. Rural. Sociol. 72, 450–477. http://dx.doi.org/10.1526/003601107781799263.
Osmund, K., 1999. The public and restoration: support—or indifference. Ecol. Restor. 17, 3. http://dx.doi.org/10.3368/er.17.1-2.3.
Ostergren, D.M., Abrams, J.B., Low, K.A., 2008. Fire in the forest: public perceptions of ecological restoration in North-Central Arizona. Ecol. Restor. 26, 51–60. http://dx.doi.org/10.3368/er.26.1.51.
Packard, S., Mutel, C.F., 2005. The Tallgrass Restoration Handbook for Prairies, Savannas, and Woodlands. Second ed. Island Press, Covelo, CA.
Pannell, D., Marshall, G., Barr, N., Curtis, A., Vanclay, F., Wilkinson, R., 2006. Understanding and promoting adoption of conservation practices by rural landholders. Aust. J. Exp. Agric. 46, 1407–1424. http://dx.doi.org/10.1071/EA05037.
Ribe, R.G., 1989. The aesthetics of forestry: what has empirical preference research taught us? Environ. Manag. 13, 55–74. http://dx.doi.org/10.1007/BF01867587.
Rubin, D.B., 1987. Multiple Imputation for Nonresponse in Surveys. John Wiley & Sons, New York.
Ruiz-Jaen, M.C., Aide, T.M., 2005. Restoration success: how is it being measured? Restor. Ecol. 13, 569–577. http://dx.doi.org/10.1111/j.1526-100X.2005.00072.x.
Ryan, R.L., 2000. A People-Centered Approach to Designing and Managing Restoration Projects: Insights from Understanding Attachment to Urban Natural Areas. In: Gobster, P.H., Hull, R.B. (Eds.), Restoring Nature: Perspectives from the Social Sciences and Humanities. Island Press, Washington, DC, pp. 209–228.
Ryan, R.L., 2005. Exploring the effects of environmental experience on attachment to urban natural areas. Environ. Behav. 37, 3–42. http://dx.doi.org/10.1177/0013916504264147.
Ryan, R.L., 2012. The influence of landscape preference and environmental education on public attitudes toward wildfire management in the Northeast pine barrens (USA). Landsc. Urban Plan. 107, 55–68. http://dx.doi.org/10.1016/j.landurbplan.2012.04.010.
Safford, T.G., Norman, K.C., Henly, M., Mills, K.E., Levin, P.S., 2014. Environmental awareness and public support for protecting and restoring Puget Sound. Environ. Manag. 53, 757–768. http://dx.doi.org/10.1007/s00267-014-0236-8.
Schulof, R., 1989. Public perceptions of native vegetation. Restor. Manag. Notes 7, 69–72.
Schultz, P.W., 2001. The structure of environmental concern: concern for the self, other people, and the biosphere. J. Environ. Psychol. 21, 327–339. http://dx.doi.org/10.1006/jevp.2001.0227.
Schwartz, A., Turbe, A., Simon, L., Julliard, R., 2014. Enhancing urban biodiversity and its influence on city-dwellers: an experiment. Biol. Conserv. 171, 82–90. http://dx.doi.org/10.1016/j.biocon.2014.01.009.
Shindler, B.A., Brunson, M., Stankey, G., 2002. Social Acceptability of Forest Conditions and Management Practices: A Problem Analysis. Gen. Tech. Rep. PNW-GTR-537. USDA Forest Service, Pacific Northwest Research Station, Portland, OR.
Shindler, B., Gordon, R., Brunson, M.W., Olsen, C., 2012. Public perceptions of sagebrush ecosystem management in the Great Basin. Rangel. Ecol. Manag. 64, 335–343. http://dx.doi.org/10.2111/REM-D-10-00012.1.
Shirmer, J., Bull, L., 2014. Assessing the likelihood of widespread landholder adoption of afforestation and reforestation projects. Glob. Environ. Chang. 24, 306–320. http://dx.doi.org/10.1016/j.gloenvcha.2013.11.009.
Shore, D., 1996. The Chicago Wilderness and its critics: II. Controversy erupts over restoration in Chicago area. Restor. Manag. Notes 15, 25–31.
Siewers, A., 1998. Making the quantum-culture leap: reflections on the Chicago controversy. Restor. Manag. Notes 16, 9–15.
StataCorp., 2015. Stata 14. Multiple-Imputation Reference Manual. State Press, College Station, TX.
Steele, J., Bourke, L., Luloff, A.E., Liao, P.S., Theodori, G.L., Krannich, R.S., 2001. The drop-off/pick-up method for household survey research. J. Commun. Dev. Soc. 32, 238–250.
Toledo, D., Sorice, M.G., Kreuter, U.P., 2013. Social and ecological factors influencing attitudes toward the application of high-intensity prescribed burns to restore fire adapted grassland ecosystems. Ecol. Soc. 18 (Article 9). http://dx.doi.org/10.5751/ES-05820-180409.
Toman, E., Shindler, B., McCaffrey, S., Bennett, J., 2014. Public acceptance of wildland fire and fuel management: panel responses in seven locations. Environ. Manag. 54, 557–570. http://dx.doi.org/10.1007/s00267-014-0327-6.
Urbanek, R.E., Nielsen, C.K., Davenport, M.A., Woodson, B.D., 2012. Acceptability and conflict regarding suburban deer management methods. Hum. Dimens. Wildl. 17, 389–403. http://dx.doi.org/10.1080/10871209.2012.684196.
Urbanek, R.E., Nielsen, C.K., Davenport, M.A., Woodson, B.D., 2015. Perceived and desired outcomes of suburban deer management methods. J. Wildl. Manag. 79, 647–661. http://dx.doi.org/10.1002/jwmg.871.
Vaske, J.J., 2008. Survey Research and Analysis: Applications in Parks, Recreation, and Human Dimensions. Venture, State College, PA.
Vining, J., Merrick, M.S., Price, E., 2008. The distinction between humans and nature: human perceptions of connectedness to nature and elements of the natural and unnatural. Hum. Ecol. Rev. 15, 1–11.
Watkins, C., Massey, D., Brooks, J., Ross, K., Zellner, M.L., 2013. Understanding the mechanisms of collective decision making in ecological restoration: an agent-based model of actors and organizations. Ecol. Soc. 18 (Article 2). http://dx.doi.org/10.5751/ES-05497-180232.
Westphal, L.M., Watkins, C., Gobster, P.H., Heneghan, L., Ross, K., Ross, L., Tudor, M., Wali, A., Wise, D.H., Vining, J., Zellner, M., 2014. Social Science Methods Used in the RESTORE Project. Gen. Tech. Rep. NRS-138. USDA Forest Service, Northern Research Station, Newtown Square, PA.
White, I.R., Royston, P., Wood, A.M., 2011. Multiple imputation using chained equations: issues and guidance for practice. Stat. Med. 30, 377–399. http://dx.doi.org/10.1002/sim.4067.
Woodworth, P., 2013. Our Once and Future Planet: Restoring the World in the Climate Change Century. University of Chicago Press, Chicago.
Wortley, L., Hero, J.-M., Howes, M., 2013. Evaluating ecological restoration success: a review of the literature. Restor. Ecol. 21, 537–543. http://dx.doi.org/10.1111/rec.12028.
Xiao, C., McCright, A.M., 2015. Gender differences in environmental concern: revisiting the institutional trust hypothesis in the USA. Environ. Behav. 47, 17–37. http://dx.doi.org/10.1177/0013916513491571.